

The opinion in support of the decision being entered today was not written for publication and is not binding precedent of the Board.

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte KIE Y. AHN and LEONARD FORBES

MAILED

Appeal No. 2006-0586
Application No. 09/755,071

MAR 24 2006

U.S. PATENT AND TRADEMARK OFFICE
BOARD OF PATENT APPEALS
AND INTERFERENCES

ON BRIEF

Before JERRY SMITH, BARRY, and LEVY, Administrative Patent Judges.
JERRY SMITH, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on the appeal under 35 U.S.C. § 134 from the examiner's rejection of claims 19-28, 30, 31, 33, 34, 37 and 39-42, which constitute all the claims pending in this application.

The disclosed invention pertains to a dual damascene interconnect structure of a semiconductor device with reduced diffusion of copper atoms to underlying damascene layers.

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Representative claim 19 is reproduced as follows:

19. A dual damascene structure comprising:

a semiconductor substrate;

a first insulating layer provided over said semiconductor substrate;

a metal layer provided within said first insulating layer;

a second insulating layer provided over said metal layer;

a via situated within said second insulating layer and extending to at least a portion of said metal layer, said via being lined with an organo-metallic-atomic deposited titanium-silicon-nitride layer having a step coverage of about 100% and filled with a copper material;

a third insulating layer located over said second insulating layer;

a trench situated within said third insulating layer and extending to said via, said trench being lined with said organo-metallic-atomic deposited titanium-silicon-nitride layer and filled with said copper material.

The examiner relies on the following references:

Venkatraman et al. (Venkatraman)	6,093,966	Jul. 25, 2000
Anand	6,362,528	Mar. 26, 2002 (filed Aug. 20, 1997)

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J. S. Reid et al. (Reid), "Ti-Si-N Diffusion Barriers Between Silicon and Copper," IEEE Electron Device Letters, Vol. 15, No. 8, August 1994, pages 298-300.

Jae-Sik Min et al. (Min), "Metal-organic atomic-layer deposition of titanium-silicon-nitride films," Applied Physics Letters, Vol. 75, No. 11, September, 13, 1999, pages 1521-1523.

Claims 19, 21, 22, 24, 25, 28 and 30 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over the teachings of Anand in view of Min. Claims 20, 23 and 40-42 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over the teachings of Anand in view of Min and further in view of Venkatraman. Claims 26 and 27 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over the teachings of Anand in view of Min and further in view of Reid. Claims 31, 33, 34, 37 and 39 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over the teachings of Anand in view of Venkatraman and Reid.

Rather than repeat the arguments of appellants or the examiner, we make reference to the briefs and the answer for the respective details thereof.

OPINION

We have carefully considered the subject matter on appeal, the rejections advanced by the examiner and the evidence of obviousness relied upon by the examiner as support for the rejections. We have, likewise, reviewed and taken into consideration, in reaching our decision, the appellants' arguments set forth in the briefs along with the examiner's rationale in support of the rejections and arguments in rebuttal set forth in the examiner's answer.

It is our view, after consideration of the record before us, that the evidence relied upon and the level of skill in the particular art would have suggested to one of ordinary skill in the art the obviousness of the invention as set forth in the claims on appeal. Accordingly, we affirm.

In rejecting claims under 35 U.S.C. § 103, it is incumbent upon the examiner to establish a factual basis to support the legal conclusion of obviousness. See In re Fine, 837 F.2d 1071, 1073, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988). In so doing, the

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examiner is expected to make the factual determinations set forth in Graham v. John Deere Co., 383 U.S. 1, 17, 148 USPQ 459, 467 (1966), and to provide a reason why one having ordinary skill in the pertinent art would have been led to modify the prior art or to combine prior art references to arrive at the claimed invention. Such reason must stem from some teaching, suggestion or implication in the prior art as a whole or knowledge generally available to one having ordinary skill in the art. Uniroyal, Inc. v. Rudkin-Wiley Corp., 837 F.2d 1044, 1051, 5 USPQ2d 1434, 1438 (Fed. Cir.), cert. denied, 488 U.S. 825 (1988); Ashland Oil, Inc. v. Delta Resins & Refractories, Inc., 776 F.2d 281, 293, 227 USPQ 657, 664 (Fed. Cir. 1985), cert. denied, 475 U.S. 1017 (1986); ACS Hosp. Sys., Inc. v. Montefiore Hosp., 732 F.2d 1572, 1577, 221 USPQ 929, 933 (Fed. Cir. 1984). These showings by the examiner are an essential part of complying with the burden of presenting a prima facie case of obviousness. Note In re Oetiker, 977 F.2d 1443, 1445, 24 USPQ2d 1443, 1444 (Fed. Cir. 1992). If that burden is met, the burden then shifts to the applicant to overcome the prima facie case with argument and/or evidence. Obviousness is then determined on the basis of the evidence as a whole and the relative persuasiveness of the arguments. See Id.; In re Hedges, 783 F.2d 1038, 1039, 228 USPQ

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685, 686 (Fed. Cir. 1986); In re Piasecki, 745 F.2d 1468, 1472, 223 USPQ 785, 788 (Fed. Cir. 1984); and In re Rinehart, 531 F.2d 1048, 1052, 189 USPQ 143, 147 (CCPA 1976). Only those arguments actually made by appellants have been considered in this decision. Arguments which appellants could have made but chose not to make in the brief have not been considered and are deemed to be waived [see 37 CFR § 41.37(c)(1)(vii) (2004)].

We consider first the examiner's rejection of claims 19, 21, 22, 24, 25, 28 and 30 based on Anand and Min. Since appellants have argued these claims as a single group, we will consider independent claim 19 as the representative claim for this group. The examiner essentially finds that Anand teaches the claimed invention except that Anand does not teach that the Ti-Si-N layer has a step coverage of about 100%. The examiner, therefore, cites Min as teaching the formation of a Ti-Si-N layer which achieves 100% coverage. The examiner finds that it would have been obvious to the artisan to form the Ti-Si-N layer in Anand using the process taught by Min so that the Ti-Si-N layer in Anand would have 100% step coverage as taught by Min. With respect to the formation of the layer using an organo-metallic-atomic deposition process, the examiner asserts that the layer is recited as a product-by-process limitation so that it is the

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layer which is claimed as opposed to the manner in which the layer is deposited. The examiner also notes, however, that Min explicitly teaches the formation of a Ti-Si-N layer using the claimed organo-metallic-atomic deposition process [answer, pages 3-5].

Appellants' arguments begin by noting individual deficiencies in the references which have been acknowledged by the examiner. That is, appellants note that Anand fails to teach an organo-metallic-atomic deposited Ti-Si-N layer while Min fails to teach a dual damascene structure. Appellants argue that the limitation "organo-metallic-atomic deposited titanium-silicon-nitride layer" recites a structural limitation and not a process limitation. Appellants also argue that a Ti-Si-N layer deposited by an organo-metallic-atomic process has different physical properties from the same layer deposited by a chemical vapor deposition process. Appellants argue that there is no motivation to combine the teachings of Min with the teachings of Anand, and that Anand is not primarily concerned with damascene processing [brief, pages 10-15].

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The examiner responds that appellants' own arguments support the examiner's position that the limitation from claim 19 quoted above is a product formed by a particular process, and the examiner disputes that the cases cited by appellants support their position. The examiner also points out that the process limitation of claim 19 was considered anyway despite the examiner's position that it was a product-by-process limitation. Finally, the examiner responds that Min provides the motivation for depositing the Ti-Si-N layer of Anand using an organo-metallic-atomic deposition process because Min teaches that it provides superior step coverage for such layers [answer, pages 8-13].

Appellants respond that the issue is not whether the Ti-Si-N layer of Anand may be formed in the claimed manner, but rather, whether there is any suggestion or motivation to form the Ti-Si-N layer of Anand in the claimed manner. Appellants assert that the rejection is nothing more than an improper hindsight "obvious to try" rejection. Appellants argue that Anand must directly suggest the desirability of forming the layer in the claimed manner and Anand fails to do that [reply brief].

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We will sustain the examiner's rejection of claims 19, 21, 22, 24, 25, 28 and 30. Although we agree with the examiner that the phrase "lined with an organo-metallic-atomic deposited titanium-silicon-nitride layer" is a product-by-process limitation, the evidence on this record, especially Min, suggests that a layer deposited using this process has structural properties that are different from such layers deposited in other ways. Therefore, the claimed product (the layer) must be deposited in the claimed manner to meet the claimed invention. As noted by the examiner, however, Min was cited because it explicitly teaches depositing a Ti-Si-N layer using the claimed process. Appellants' argument that Anand must suggest this proposed modification is incorrect because if it did, Anand would anticipate the claimed invention. The dual damascene structure as claimed exists within the structure disclosed by Anand except for the process used to deposit the Ti-Si-N layer. Min specifically teaches that a Ti-Si-N layer deposited in the claimed manner has advantageous properties over the conventional

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chemical-vapor deposition process. The advantageous step coverage properties taught by Min would clearly be useful in the structure disclosed by Anand. This modification of Anand is not an improper "obvious to try" rejection because there is no evidence that the claimed process is simply one of a large number of possibilities, and because Min specifically teaches that this modification produces superior results. Thus, the result of this modification is completely expected to be advantageous based on this record.

We now consider the examiner's rejection of claims 20, 23 and 40-42 based on Anand, Min and Venkatraman. Since appellants have argued these claims as a single group, we will consider dependent claim 20 as the representative claim for this group. The examiner essentially finds that the Anand and Min combination teaches the claimed invention except for the insulating layers being formed of polyimide, which is one member of the claimed group. The examiner, therefore, cites Venkatraman as teaching the use of polyimide as an insulating layer. The examiner finds that it would have been obvious to the artisan to form the insulating layers in Anand using the polyimide as taught by Venkatraman [answer, pages 5-6].

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Appellants argue that Venkatraman does not make up for the deficiencies in Anand and Min. Appellants also make general assertions that the applied references fail to teach the claimed insulating layer that includes a material selected from the claimed group. Finally, appellants argue that there is no motivation to combine the teachings of Anand and Min [brief, pages 16-19].

The examiner responds by explaining how the applied prior art renders the claimed invention obvious within the meaning of 35 U.S.C. § 103 [answer, pages 13-14].

We will sustain the examiner's rejection of claims 20, 23 and 40-42. The examiner's findings with regard to the teachings of the references and the motivation for combining the teachings of the references are sufficient to have established a prima facie case of obviousness. Appellants' arguments are either incorrect for reasons discussed above or are too vague and general to persuasively rebut the examiner's prima facie case of obviousness.

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We now consider the examiner's rejection of claims 26 and 27 based on Anand, Min and Reid. Since appellants have argued these claims as a single group, we will consider dependent claim 26 as the representative claim for this group. The examiner essentially finds that the Anand and Min combination teaches the claimed invention except for the Ti-Si-N layer having the claimed thickness. The examiner, therefore, cites Reid as teaching a Ti-Si-N layer having the claimed thickness. The examiner finds that it would have been obvious to the artisan to form the Ti-Si-N layer in Anand using the thickness as taught by Reid [answer, pages 6-7].

Appellants argue that Reid does not make up for the deficiencies in Anand and Min. Appellants also argue that there is no motivation to combine the teachings of Anand and Min [brief, pages 19-20]. The examiner responds by explaining how the applied prior art renders the claimed invention obvious within the meaning of 35 U.S.C. § 103 [answer, pages 14-15].

We will sustain the examiner's rejection of claims 26 and 27. The examiner's findings with regard to the teachings of the

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references and the motivation for combining the teachings of the references are sufficient to have established a prima facie case of obviousness. Appellants' arguments are either incorrect for reasons discussed above or are too vague and general to persuasively rebut the examiner's prima facie case of obviousness.

We now consider the examiner's rejection of claims 31, 33, 34, 37 and 39 based on Anand, Venkatraman and Reid. Since appellants have argued these claims as a single group, we will consider independent claim 31 as the representative claim for this group. The rejection is based on findings by the examiner that we have considered above [answer, page 7]. Appellants' arguments appear to simply point out individual deficiencies of the references and that neither applied reference fully teaches the claimed invention. Appellants also assert generally that there is no motivation for combining the references [brief, pages 22-24]. The examiner responds that all of appellants' arguments were addressed within the rejection or within the response to arguments considered above.

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We will sustain the examiner's rejection of claims 31, 33, 34, 37 and 39. We find that the examiner has established at least a *prima facie* case of obviousness, and appellants' arguments fail to persuasively address the examiner's findings in support of the rejection.

In summary, we have sustained each of the examiner's rejections of the claims on appeal. Therefore, the decision of the examiner rejecting claims 19-28, 30, 31, 33, 34, 37 and 39-42 is affirmed.

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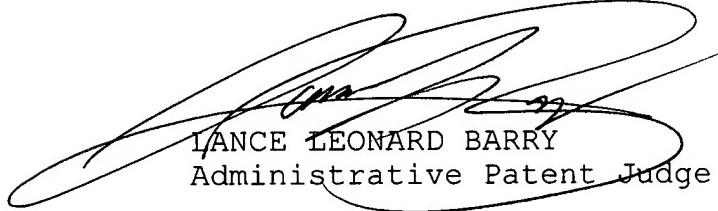
No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a)(1)(iv).

AFFIRMED



JERRY SMITH
Administrative Patent Judge

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